Osamu NOMURA, et al. CASTING NOZZLE Mark Boland January 31, 2005 1 of 15

Q86054

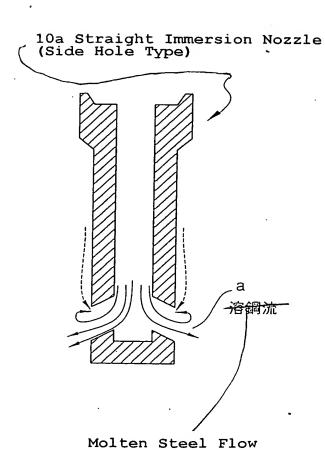
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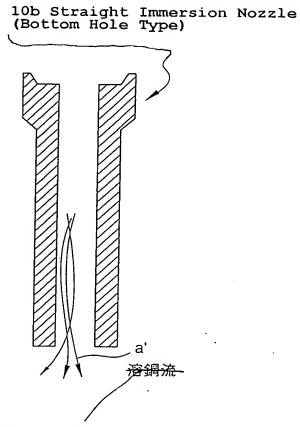
10/522680

Fig. 1

(A)

(B)





Molten Steel Flow

202-293-7060

of 15 10/522680

·FIG. 2

		Exa	mple
		1	2
	Diameter D (mm) of Inner Hole Portion	80	90
		Elliptic	Spherical
Protrusions	Approximate Shape		_
	Maximum Height H (mm)	8	10
	Maximum Length L (mm) of Base Portion	32	27
	Number of disposed Protrusions	54	70
	L/H	4.0	2.7
	πD/L	7.9	10.5
Surface Area	a Increasing Rate (%)	116	114
	Degree of Drift	Мо	No
Water Model	Minus Flow (Presence or Absence of Suction Flow)	Absent	Absent
	Strength of Protrusions	OK	OK
Actual Machine	Deposition (mm) of Alumina on Inner Pipe	1	0
Tota	al Evaluation	0	0

	Example								
3	4	5	6	7	8				
80	80	80	60	80	80				
Spherica 1	Spherica 1	Conical	Trapezoi d	Trapezoi d	Trapezoi d				
_	_								
2	5	10	5	15	10				
10	15	22	58	31	21				
60	50	90	30	230	250				
5.0	3.0	2.2	11.6	2.1	2.1				
25.1	16.7	11.4	3.2	8.1	12.0				
102	106	115	119	345	240				
No	No	No	No	No	No				
Absent	Absent	Absent	Absent	Absent	Absent				
OK	OK	OK	OK	OK	OK				
3	1	1	0	3	0				
0	0	0	0	0	0				

· FIG. 3

		Comparative E:	xample
		1	2
	Diameter D (mm) of Inner Hole Portion	80	90
		Stepped	Straight
Protrucion	Approximate Shape		None
Protrusions	Maximum Height H (mm)	5	_
	Maximum Length L (mm)	(circumferential	_
	of Base Portion	length: 251)	_
	Number of disposed Protrusions	1	0
	L/H	(50.2)	_
-	πD/L	1.0	-
Surface Area	Increasing Rate (%)	97	100
	Degree of Drift	Middle	Large
Water Model	Minus Flow (Presence or Absence of Suction Flow)	Present	Present
Actual	Strength of Protrusions	ok	_
Machine	Deposition (mm) of Alumina on Inner Pipe	8	12
Tota	l Evaluation	×	×

		Comparativ	re Example		
3	4	5	6	7	8
80	80	80	60	80	80
Spherica l	Conical	Spherica 1	Spherica 1	Elliptic	Trapezoi d
		_	_	_	
10	5	1	5	2	12
8	3	10	10	3	24
50	50	50	50	80	350
0.8	0.6	10.0	2.0	1.5	2.0
31.4	83.7	25.1	25.1	83.7	10.5
115	103	102	104	101	364
No	Мо	Large	Small	Middle	Small
Absent	Absent	Present	Absent	Present	Present
NG	NG	OK	NG	NG	OK
6	6	10	5	6	7
×	×	×	×	×	×

Osamu NOMURA, et al. Q860 CASTING NOZZLE Mark Boland 202-293-7 January 31, 2005 4 of 15 10/522680 202-293-7060 Single-Stepped Immersion Nozzle 22 Inner Hole Portion (Molten Steel Flow Hole Portion) 21 Body Portion . 20 α 23 Powder Line Portion 24
Elliptical Protrusion Portion

Q86054

Osamu NOMURA, et al. CASTING NOZZLE Mark Boland January 31, 2005 5 of 15

Q86054

202-293-7060

10/522680

30 Straight Immersion Nozzle 32 Inner Hole Portion (Molten Steel Flow Hole Portion) - 31 Body Portion α 34 Spherical Protrusion Portion 33 Powder Line Portion

Osamu NOMURA, et al. CASTING NOZZLE Mark Boland January 31, 2005 6 of 15

Q86054

202-293-7060

10/522680

5 mm from Lower End 5 mm from Upper End Center 10mm **∞ ⊚** Propeller Flowmeter X Discharge Hole Surface Center $\stackrel{\text{(a)}}{=}$ \bigcirc (2) 9 **⊘** Θ <u>(</u> 5mm 50 20~ Immersion Nozzle

F. 19. 6

10/522680

FIG. 7

(A)

[Immersion Nozzle according to Comparative Example 1]

[Throughput: equivalent to 3 steel T/min]

	Left			Right		
	Rear	Center	Front	Front	Center	Rear
Upper	39	3	-1	8	49	51
Center	13	16	8	41	11	3
Lower	-2	36	38	58	-9	9

[Throughput: equivalent to 5 steel T/min]

	Left			Right		
	Rear	Center	Front	Front	Center	Rear
Upper	88	22	-6	20	83	103
Center	14	31	12	70	22	7
Lower	-18	60	68	. 96	-10	-1

[Throughput: equivalent to 7 steel T/min]

	Left			Right		
	Rear	Center	Front	Front	Center	Rear
Upper	102	40	0	22	97	106
Center	27	27	32	78	38	21
Lower	6	95	75	98	19	10

Flow Rate	手前 中央 奥
0>	1 1 1
0-50	
50-100	
100<	
	Front Center Rear Upper
	Center
	Lower

202-293-7060

Mark Boland January 31, 2005 8 of 15

10/522680

(B)

[Immersion Nozzle according to Example 1]

	Left			Right		
Ī	Rear	Center	Front	Front	Center	Rear
Upper	3	13	18	23	20	12
Center	18	16	18	25	26	27
Lower	41	43	2	25	36	22

	Left			Right		
	Rear	Center	Front	Front	Center	Rear
Upper	41	27	16	24	39	55
Center	11	21	36	39	32	22
Lower	15	77	41	62	52	12

	Left			Right		
	Rear	Center	Front	Front	Center	Rear
Upper	122	59	26	37	62	98
Center	32	32	38	63	60	42
Lower	55	66	62	98	43	29

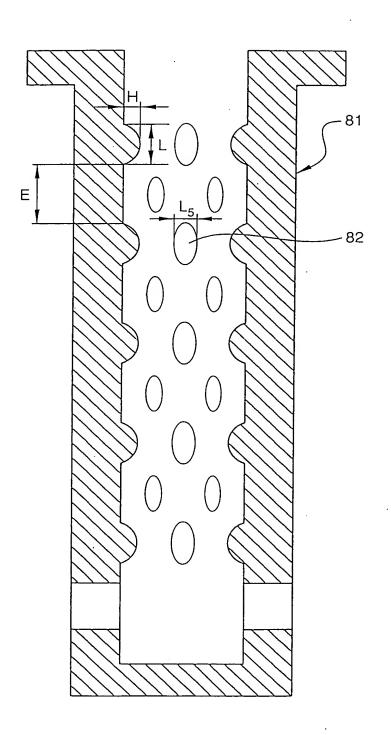
Osamu NOMURA, et al. CASTING NOZZLE Mark Boland January 31, 2005 9 of 15

202-293-7060

Q86054

10/522680

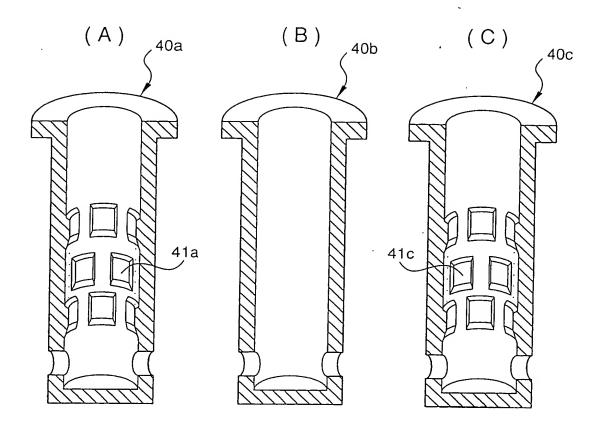
Fig. 8

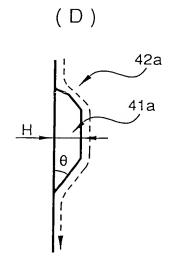


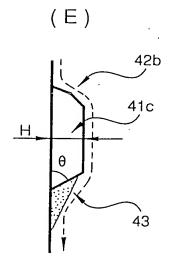
Osamu NOMURA, et al. Q86054
CASTING NOZZLE
Mark Boland 202-293-7060
January 31, 2005
10 of 15 1 0 / 5 22 6 8 0

Q86054

Fig. 9







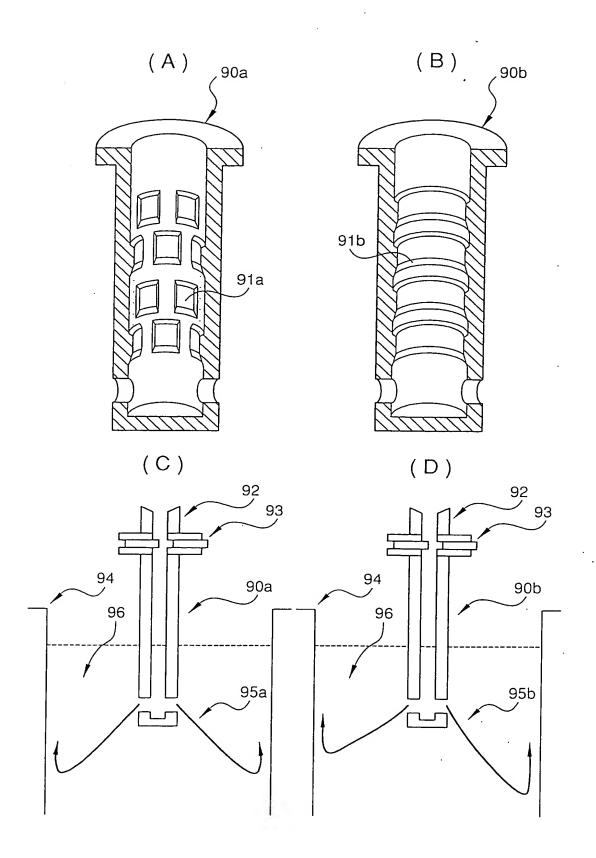
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Q86054

202-293-7060

Fig. 10

10/522680



Osamu NOMURA, et al.
CASTING NOZZLE
Mark Boland
January 31, 2005
12 of 15

Q86054 202-293-7060

0/522680

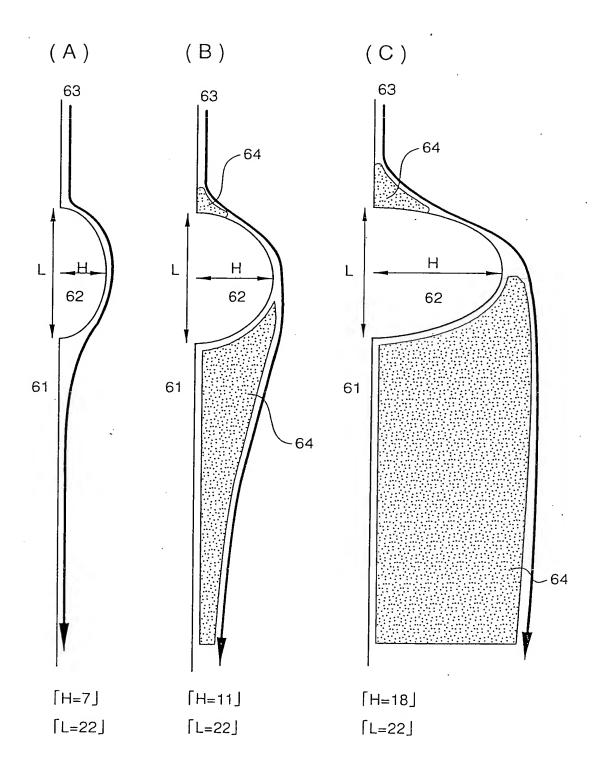
FIG. 11

	•	Example						
	12	13	14	15	16			
Sectional Shape of Protrusion Portion	θ=38°	θ=35°	θ=13°	θ = 27°	θ =58°			
Presence or Absence of Stagnation just under Protrusion	Absent	Absent	Absent	Absent	Absent			
Straighten ing Effect	Good	Good	Good	Good	Good			

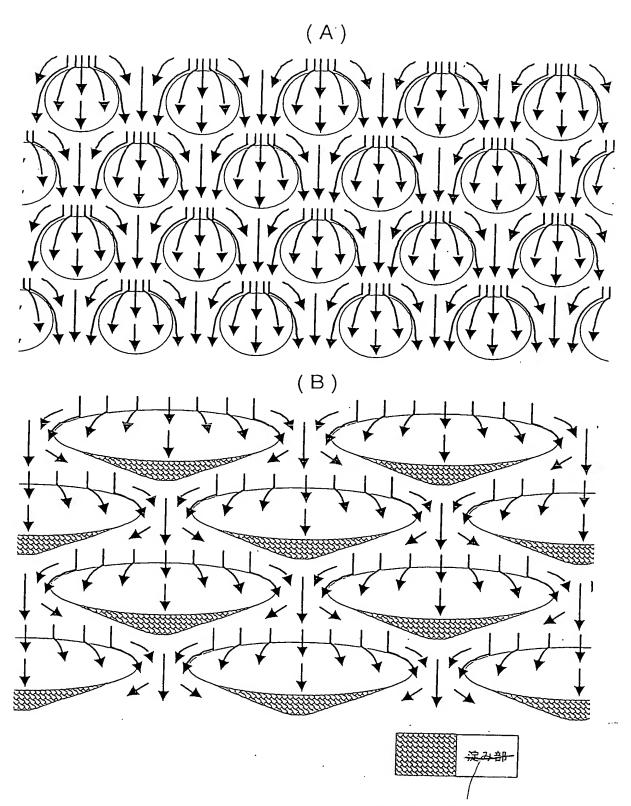
	Comparative Example				
	14	15	16	17	18
Sectional Shape of Protrusion Portion	θ=72°	θ = 77°	θ=70°	θ=90°	θ=90°
Presence or Absence of Stagnation just under Protrusion	Present	Present	Present	Present	Present
Straighten ing Effect	Bad	Bad	Bad	Bad	Bad

Osamu NOMURA, et al. Q86054
CASTING NOZZLE
Mark Boland
January 31, 2005 0 / 5 2 2 6 8 0

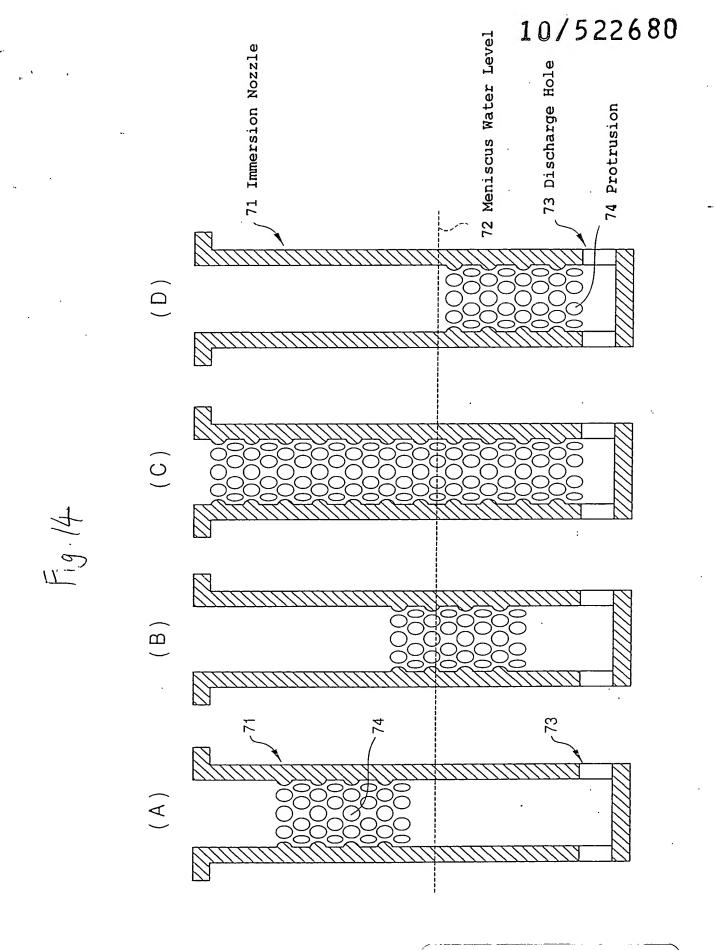
Fig. 12



Osamu NOMURA, et al. Q86054
CASTING NOZZLE
Mark Boland 202-293-7060
January 31, 2005
14 of 15 10/522680



Stagnation Portion



Osamu NOMURA, et al. CASTING NOZZLE Mark Boland January 31, 2005 15 of 15

Q86054

202-293-7060

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